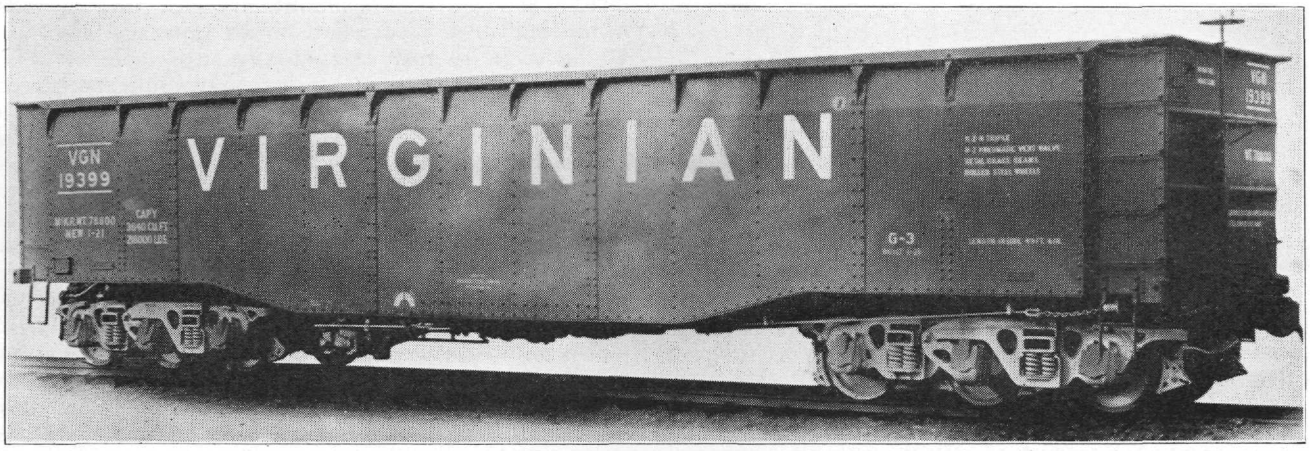

THE WHEELED GIANTS

One Hundred and Twenty-Ton Coal Cars in Service on the Virginian

By A. H. DIERKER, '26

IT might be well to give, before starting our topic, a few facts concerning the railroad whose progressive policies have led it to build cars of the high capacity noted in the title of this article.

The Virginian Railway was built for the specific purpose of transporting coal from the New River and Pocahontas fields of West Virginia to tidewater at Sewall's Point near Norfolk, Virginia. More than 90% of the freight hauled on its main line of 442 miles consists of coal. This specialization has led to the development of equipment until now the Virginian operates the heaviest cars and most powerful locomotives in use today. For those who have any doubt as to the success of such a single purpose road, it might be said that the Virginian is one of the few roads which have consistently operated at a profit, during and since government control.

REASONS FOR HEAVY CARS

When operations were started on the Virginian in 1909 the equipment consisted of cars and locomotives that were standard on the railroads at that time. Trains consisted of eighty 55-ton gondolas, making a gross load of 6,000 tons behind the locomotive. Later the trains were increased to eighty-five cars and this practice was continued until 1914. By this time traffic had increased to a point where to handle it adequately would mean either double tracking the road or considerably increasing the train capacity. The latter of course was decided upon.

It was not found advisable to materially increase the length of the already long trains, so the only solution of the problem lay in increasing the capacity of the individual cars. This was done with the result that the Virginian now has 2,000 cars of 120 tons net capacity in successful operation.

DETAILS

A good idea of the advantages of these new cars can be obtained by comparing them with the old. The 120-ton capacity cars weigh 78,900 lbs., compared with 41,000 lbs. for the 55-ton gondolas, making a ratio of load to dead weight of 75.3% and 74.5% respectively. The new cars have little advantage here. This is because the heavier cars require six-wheel trucks and heavier equipment throughout. However, the 120-ton cars have only six axles to carry the same load carried by the eight axles on two of the old cars, and it has been found that less force is required to move the more concentrated load.

The 120-ton cars are 49 feet 6 inches long inside, while the old gondolas were 40 feet. Thus the gross weight per foot of length has been increased 61.7%, which means that more than 60% additional freight can be handled with the same length of train.

The design of these cars brought out some interesting problems and we shall attempt to show how some of them were solved.

SIX WHEEL TRUCKS

Since freight cars will often be required to run over tracks of light construction (mine spurs, etc.), it has not been found practical to equip cars of more than 70 tons capacity with four-wheel trucks. Hence the new 120-ton cars are equipped with six-wheel trucks.

The chief requirements of a truck for freight cars are:

1. Equalization of load on all journals. This is necessary, not only to prevent overloading of any one journal, but also to prevent derailment due to absence of load on any one journal, especially those of the "corner" wheels.

2. Flexibility that permits operation over rough and uneven tracks without destroying the equalization.

3. Short wheel base so that car can be operated around sharp curves.

4. Simplicity and ease of parts replacement. Freight cars must often be repaired in places where there are no special facilities for such work.

The six-wheel truck which apparently answers these requirements is shown in Fig. 2 and is the truck with which most of the 120-ton cars have been equipped.

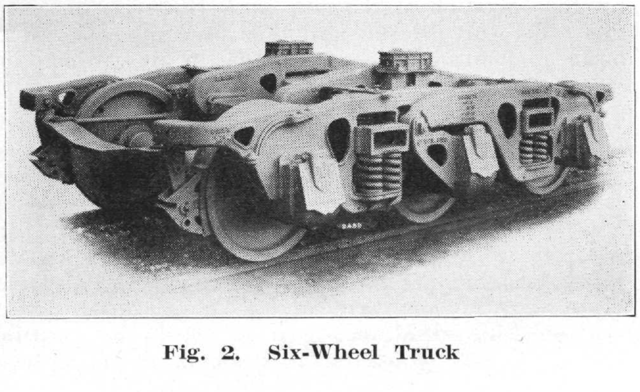

Fig. 2. Six-Wheel Truck

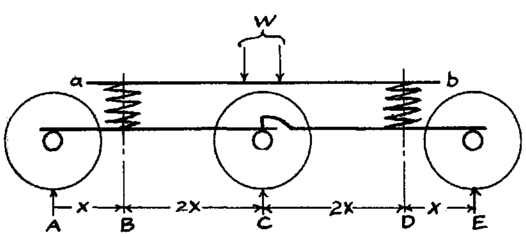

Fig. 3

Equalization of this truck has been secured by a very ingenious application of mechanics as illustrated in Figs. 4 and 5. Fig. 3 represents the load diagram of the simplests type of six-wheel truck. You will note that the load, W, of the car is not applied at a single point, but over an area, the distance between the two arrows representing the diameter of the center plate upon which the car body rests. For this reason bolster *ab* has a tendency to remain horizontal. If, in this type of truck, one wheel, say A, is raised slightly higher than the others, spring B will be depressed and the load on wheel A will be increased and decreased on wheel B. This type of truck, then, equalizes only when the journals are in a straight line, i. e., when the track is level and rigid.

Fig. 4 shows how perfect equalization can be secured, regarless of the relative position of the wheels. If one wheel, say A, is raised higher than the others, the load at *f* will tend to increase. This will rotate the equalizer *fg*, depressing *f* and raising *g* until the loads at both points, *f* and *g*, are equal. If the loads at *f* and *g* are equal, then the loads on A′, C′ and E′ must be equal.

The wheel base of the truck can be shortened to a minimum by arranging the members as shown in Fig. 5. With the members in this position we have the load diagram of the truck shown in Fig. 2. Equalizer *fg* is normally in unstable equilibrium, but is held in this position due to the resistance of the springs to distortion.

Air Brakes

Most readers are perhaps familiar with the operation of the automatic air brake which is standard equipment on all freight cars in the United States. However, a few general remarks might be in place here. Each car is equipped in addition to the brake cylinder, with an air reservoir and triple valve. The brake cylinder is operated with air from this local reservoir and not from the main locomotive reservoir. A decrease in train line (the air pipe running from car to car) pressure actuates the triple valve in such a manner as to cause air to flow from the reservoir into the brake cylinder, thus setting the brakes. An increase in train line pressure releases the air in the brake cylinder, thus releasing the brakes. In case of any accident which would break the train line, the brakes on the entire train would be set automatically.

It was found that a braking ratio (ratio of brake shoe pressure to gross weight of car) of 40% was necessary for the operation of the new car. However, to secure this ratio with the standard type of equipment, would mean an increase of around 400% in air consumption

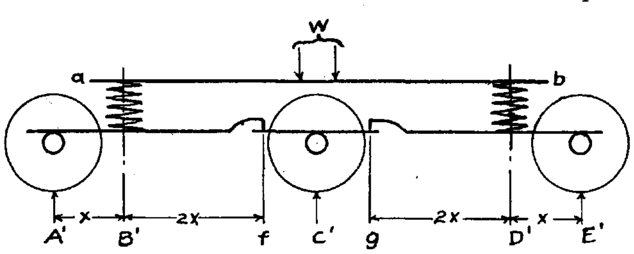

Fig. 4

over that required by an ordinary car. The 1¼-inch train line which is standard on all railroads was found to be small to take care of any such increase in air consumption, and since these cars would necessarily be used in trains with other types it would be impractical to increase the size of the pipe. Another problem arises with the use of powerful brakes; namely, brakes powerful enough to handle loaded trains on heavy grades will retard empty cars so suddenly as to cause serious train shocks. Both problems were solved by the use of a "double capacity brake."

This "double capacity" equipment consists of the usual reservoir, 10-inch brake cylinder and a triple valve, with the addition of a 16-inch brake cylinder and a small 4-inch cylinder; this 4-inch cylinder being placed within the 10-inch cylinder. There is a special valve operated manually and having load and empty position, and a slight reduction in train line pressure brings the 4-inch cylinder into play, taking up all the slack in the brake system and bringing the shoes against the wheels. A further reduction brings the 10-inch cylinder into play and a still further reduction operates the 16-inch cylinder. By this method the effective pressure of large piston area is secured with little piston travel, which means small air consumption. (The air consumption of these brakes is only 33 per cent more than that used on ordinary cars.) With the valve in empty position the 16-inch valve is cut out from the system, only the 4-inch and 10-inch cylinders being used, which gives the proper braking ratio for the empty car.

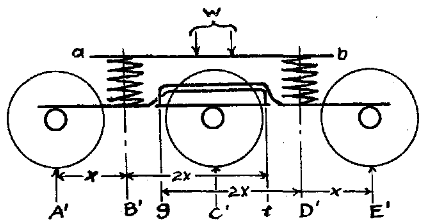

Fig. 5

Pressure is applied to the wheels by means of clasp brakes, i. e., two shoes to each wheel. This was necessary because of the high braking pressure required, approximately 11,000 pounds per wheel.

Car Body

The car body is designed as a girder with all members, sills and body bolsters placed inside. This design has several advantages. The load is supported by the car body and no heavy underframe is required. The members by being placed inside the car body, permit the space between them to be used for cargo, thus increasing the cubical capacity of the car. The outside of the car presents a smooth surface much desired where they are handled by car dumpers as all these cars are.

Test Run

Shortly after the cars were placed in service a test run was made with a train of 100 of these 120-ton cars, loaded to capacity. This train, 5,300 feet long, represented a gross weight of 16,000 tons behind the locomotive. The train was handled by a 2-10-10-2 type Mallet locomotive. This locomotive, weighing 898,300 pounds and with a tractive effort of 147,000 pounds, seems to be about the limit in size for steam locomotives.

The maximum speed of the train was around 25 miles per hour. For the person interested in large figures, we might say that at this speed the train has a momentum of 1,210,352,320 foot pounds per second. Motorists in 3,000-pound automobiles who like to play tag with railroad trains might profitably ponder over this figure.

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WHEELED GIANTS

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Just recently the Virginian found that its giant Mallet locomotives were too small to handle the heavy trains at the speed required by rapidly increasing traffic. Experiments with larger steam locomotives were unsuccessful, so the road turned to electricity. The Virginian officials examined the most powerful electric locomotives that had been built up to this time and then placed orders for a number that were to be 50 per cent larger. But that is another story.